

Claims

1. A method of reading a magnetic tag having at least one magnetic element, comprising:

5 interrogating the tag with a scanning magnetic field;
determining transition data associated with changes in the magnetisation state of the at least one magnetic element;
associating the transition data with one or more respective elements; and
for each element, determining the element direction which corresponds to
10 the transition data for that element.

2. A method according to claim 1, wherein the step of determining the element direction comprises selecting the direction which minimises the scatter of transition field vectors resolved along the direction of the element.

15 *b1 b2 A* 3. A method according to claim 1 or 2, including grouping the transition data by the type of element transition.

20 4. A method according to claim 3, comprising grouping first and second types of element transition.

5. A method according to claim 4, wherein the first type of element transition comprises a forward transition and the second type of element transition comprises a reverse transition.

25 *b1 b3 A* 6. A method according to claim 4 or 5, wherein a signal defining a transition is received by one or more receiver coils, including determining the type of transition in accordance with the polarity of the rate of change of the field vector in the direction of the element.

30 7. A method according to claim 4, 5 or 6, including determining information relating to the switching fields for each of the first and second types of transition.

8. A method according to claim 7, comprising determining element characteristics from said switching field information relating to transition data associated with an element.

5 9. A method according to claim 8, further comprising calculating the coercivity of the element as substantially half the difference between first and second switching fields.

10 10. A method according to claim 8 or 9, further comprising calculating the bias field on the element as substantially the sum of first and second switching fields.

15 11. A method according to claim 9 or 10, wherein the first switching field comprises the mean value of the switching fields for the first type of transition and the second switching field comprises the mean value of the switching fields for the second type of transition.

20 12. A method according to any one of the preceding claims, including associating the transition data with one or more respective elements using a receiver vector whose components represent the amplitudes of the signals in one or more receive coils.

13. A method according to any one of the preceding claims, comprising scanning the tag using a rotating magnetic field.

25 14. A method according to claim 13, in which the tag comprises a plurality of magnetic elements, further comprising associating transition data with respective elements in accordance with the order in which the elements transition in response to the rotating field.

30 15. A method according to any one of the preceding claims, comprising determining the coercivity, the local magnetic field bias resolved in the direction of the or each magnetic element and the orientation of the or each magnetic element relative to a known interrogation field reference frame.

16. A method according to any one of the preceding claims, further comprising determining the amplitude response of the or each magnetic element to the applied magnetic field.

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17. A method of distinguishing between a plurality of magnetic elements, comprising the steps of:

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applying a scanning magnetic field to the elements;
determining the direction of each of the elements;
for each of the elements, determining the components of the field in the direction of the element at which the element switches magnetisation states; and
from said components, determining, for each of the elements, respective characteristics of the element.

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18. A method according to claim 17, comprising determining first and second switching components as the components when the rate of change of the field along the direction of the element is positive and negative respectively.

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19. A method according to claim 17 or 18 wherein the respective characteristics comprise the coercivities of the elements.

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20. A method according to any one of claims 17 to 19, comprising storing data by reference to the respective characteristics of the elements.

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21. A method according to claim 20, wherein data is storable by reference to any one or more of orientation of the elements, coercivity, bias field along the element and amplitude response.

22. A method according to claim 20 or 21, wherein data is storable by reference to parameters relating to any one or more of rate of change of applied field, perpendicular field, response time, characteristic response shape and the statistical distribution of the parameters.

23. A method of determining, for a magnetic element, any one or more of a plurality of characteristics comprising the coercivity of the element, the local magnetic field bias resolved in the direction of the element and the orientation of the element, comprising the steps of:

- 5 applying a varying magnetic field to the element;
- determining the direction of the element;
- determining the components of the field in the direction of the element at which the element switches magnetisation states; and
- 10 from said components, determining the one or more characteristics of the element.

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24. A computer program, which when run on a computer, is configured to carry out the steps of any one of claims 1 to 23.

15 25. A magnetic tag reader for reading a magnetic tag having at least one magnetic element, comprising:

- means for interrogating the tag with a scanning magnetic field;
- means for determining transition data associated with changes in the magnetisation state of the at least one magnetic element;
- 20 means for associating the transition data with one or more respective elements; and
- means for determining, for each element, the element direction which corresponds to the transition data for that element.

25 26. A tag reader according to claim 25, wherein the scanning field comprises a rotating magnetic field.

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30 27. A tag reader according to claim 25 or 26, further comprising means for selecting the element direction which minimises the scatter of transition point field vectors resolved along the direction of the element.

28. A tag reader according to any one of claims 25 to 27, wherein the transition data includes data defining first and second switching fields at which an element undergoes first and second transitions.